

MARS INFLATABLE ROVER MISSION

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Abstract

This paper represents a logical evolution of NASA's inflatable technology research and development programs and demonstrates how inflatable technology can be used in a number of areas to reduce spacecraft mass while increasing system capabilities. JPL has already demonstrated how inflatable structures can greatly reduce system mass and manufacturing cost for antenna systems. Currently, work is under way to develop technology for the Next Generation Space Telescope inflatable sunshield, solar sails, soil moisture radiometers and mobile communication satellites. Now the combination of inflatable systems herein described, along with nanorover electronics and DS-2 type communications, will develop a significantly lighter Mars rover that has vastly increased power, traveling speed, range, and climbing capabilities. Although the Pathfinder Sojourner represented a tremendous leap in rover technology at the time, the small 11 kg Sojourner rover could only travel *around* large rocks, and never traveled more than 7 meters away from its Pathfinder base. By comparison, the Athena rover, scheduled for Mars launch in 2001, is considerably larger (52 kg) and is capable of traveling at least 10 km distance. **Using inflatable technology for the wheels, chassis, and the photovoltaic power source, an inflatable rover can accomplish similar traverses as the Athena rover, but with a factor of over seven mass reduction.** This reduction represents significant advances for other space applications such as general lightweight power systems, lightweight rigidizable components for space structures and antenna communications systems.

A quarter-scale inflatable rover (38 cm diameter wheels, Figure 1, scaled up four times on this photograph) and a half scale inflatable rover (75 cm diameter wheels) have already successfully demonstrated that inflatable rover technology can be used to build lightweight, strong vehicles that can climb rocks which are about 1/3 the wheel diameter. Since it is generally believed that about 99% of the Martian surface contains rocks that are less than 0.5 meter high, than an inflatable vehicle with 1.5 m diameter wheels should be capable of climbing rocks up to 0.5 m high, and thus traversing the vast majority of the Martian surface.

For each of these rovers, the design is relatively straightforward with a minimum of both mass and complexity. Each front wheel has a separate, independent motor to allow variable torque in climbing rocks. The trailing wheel acts merely as a torque stabilizing device and is pulled over rocks by the combined drive of the front two wheels. The fourth inflated sphere, above the wheels, represents a simulated solar photovoltaic power source, although the existing small scale rovers are actually operated by battery power.

The inflatable rover would be delivered to the Martian surface by means of using a solar heated, hot air parachute, as shown in Figure 2. Total mass of the rover itself is estimated to be about 7 kg, and total system entry mass is currently estimated to be only about 20 kg. Thus this mission could easily fit into the French Ariane 5 piggyback launches to Earth geosynchronous transfer orbit.



FIGURE 1. FULL SCALE INFLATABLE ROVER

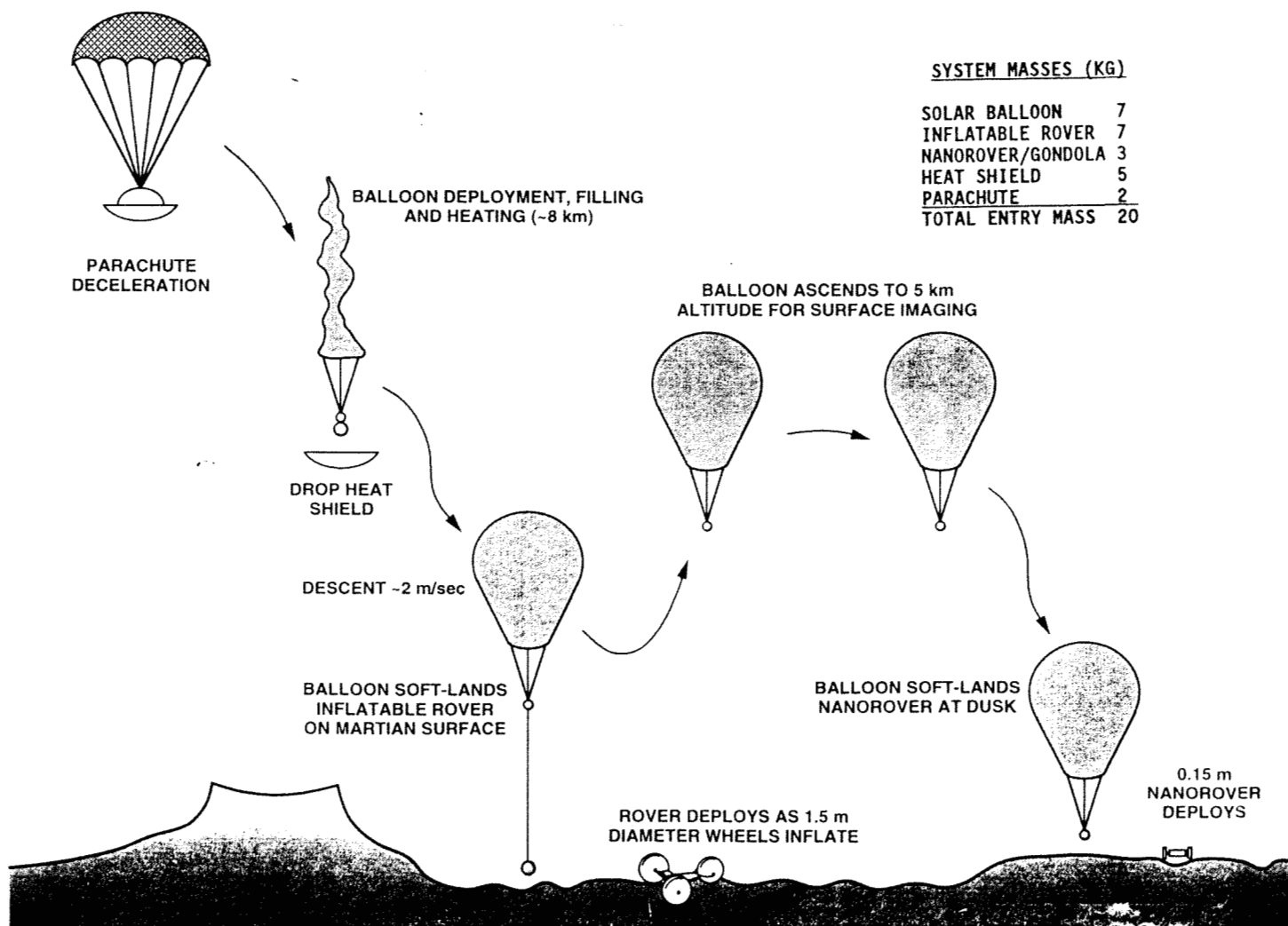


FIGURE 2. SOLAR PARACHUTE DELIVERY SYSTEM